

### NO CALCULATOR PROBLEMS

1. If 87 grams of  $K_2SO_4$  (molar mass 174 grams) is dissolved in enough water to make 250 milliliters of solution, what are the concentrations of the potassium and the sulfate ions?

	$[K^+]$	$[SO_4^{2-}]$
(A)	0.020 M	0.020 M
(B)	1.0 M	2.0 M
(C)	2.0 M	1.0 M
(D)	2.0 M	2.0 M
(E)	4.0 M	2.0 M

2. Equal volumes of 0.10-molar  $H_3PO_4$  and 0.20-molar KOH are mixed. After equilibrium is established, the type of ion in solution in largest concentration, other than the  $K^+$  ion, is

- (A)  $H_2PO_4^-$
- (B)  $HPO_4^{2-}$
- (C)  $PO_4^{3-}$
- (D)  $OH^-$
- (E)  $H_3O^+$

3.  $H_2C_2O_4 + 2 H_2O \rightleftharpoons 2 H_3O^+ + C_2O_4^{2-}$   
Oxalic acid,  $H_2C_2O_4$ , is a diprotic acid with  $K_1 = 5.36 \times 10^{-2}$  and  $K_2 = 5.3 \times 10^{-5}$ . For reaction above, what is the equilibrium constant?

- (A)  $5.36 \times 10^{-2}$
- (B)  $5.3 \times 10^{-5}$
- (C)  $2.8 \times 10^{-6}$
- (D)  $1.9 \times 10^{-10}$
- (E)  $1.9 \times 10^{-13}$

4. A hydrocarbon gas with an empirical formula  $CH_2$  has a density of 1.88 grams per liter at  $0^\circ C$  and 1.00 atmosphere. A possible formula for the hydrocarbon is

- (A)  $CH_2$
- (B)  $C_2H_4$
- (C)  $C_3H_6$
- (D)  $C_4H_8$
- (E)  $C_5H_{10}$

5. A 0.20-molar solution of a weak monoprotic acid, HA, has a pH of 3.00. The ionization constant of this acid is

- (A)  $5.0 \times 10^{-7}$
- (B)  $2.0 \times 10^{-7}$
- (C)  $5.0 \times 10^{-6}$
- (D)  $5.0 \times 10^{-3}$
- (E)  $2.0 \times 10^{-3}$

6.

Mass of an empty container = 3.0 grams

Mass of the container plus the solid sample = 25.0 grams

Volume of the solid sample = 11.0 cubic centimeters

The data above were gathered in order to determine the density of an unknown solid. The density of the sample should be reported as

- (A)  $0.5 \text{ g/cm}^3$
- (B)  $0.50 \text{ g/cm}^3$
- (C)  $2.0 \text{ g/cm}^3$
- (D)  $2.00 \text{ g/cm}^3$
- (E)  $2.27 \text{ g/cm}^3$

7. As the temperature is raised from  $20^\circ \text{C}$  to  $40^\circ \text{C}$ , the average kinetic energy of neon atoms changes by a factor of

- (A)  $1/2$
- (B)  $(313/293)^{1/2}$
- (C)  $313/293$
- (D) 2
- (E) 4

8. The solubility of  $\text{CuI}$  is  $2 \times 10^{-6}$  molar. What is the solubility product constant,  $K_{\text{sp}}$ , for  $\text{CuI}$ ?

- (A)  $1.4 \times 10^{-3}$
- (B)  $2 \times 10^{-6}$
- (C)  $4 \times 10^{-12}$
- (D)  $2 \times 10^{-12}$
- (E)  $8 \times 10^{-18}$

9. The mass of element Q found in 1.00 mole of each of four different compounds is 38.0 grams, 57.0 grams, 76.0 grams, and 114 grams, respectively. A possible atomic weight of Q is

- (A) 12.7
- (B) 19.0
- (C) 27.5
- (D) 38.0
- (E) 57.0

10. A 27.0-gram sample of an unknown hydrocarbon was burned in excess oxygen to form 88.0 grams of carbon dioxide and 27.0 grams of water. What is a possible molecular formula of the hydrocarbon?

- (A)  $\text{CH}_4$
- (B)  $\text{C}_2\text{H}_2$
- (C)  $\text{C}_4\text{H}_3$
- (D)  $\text{C}_4\text{H}_6$
- (E)  $\text{C}_4\text{H}_{10}$